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## Redescription and species limits of *Microtus irani* Thomas, 1921, and description of a new social vole from Turkey (Mammalia: Arvicolinae)

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**Abstract.** The type series of *Microtus irani* morphologically differs from the social voles living in Iran and Turkey usually ascribed to this species. The true *M. irani* is characterised by the longer tail, more expanded zygomatic arches, narrow bullae, and a strong alveolar process with a short and heavy distal portion of the articular process. Due to the lack of karyological data from Iran, it is best to consider *M. irani* as an independent species, known only from its type locality. However, the social voles from central Anatolia with the diploid number  $2n = 60$  as described by Kefelioğlu & Kryštufek (1999) are morphologically very different from *M. irani*. These voles represent a new species, *Microtus anatolicus* sp. n., which amongst the social voles of Turkey is clearly characterised by its unique karyotype and skull peculiarities, that is the enlarged bullae and broad braincase.

**Key words.** *Microtus irani*, *Microtus anatolicus* sp. n., taxonomy, Near East.

### Introduction

Oldfield Thomas described and named *Microtus irani* in a report by Cheesman (1921) on a collection of mammals from Shiraz, Iran. The collection was made between 10 February and 16 December 1919 by Colonel Hutson and presented to the British Museum of Natural History in London. Thomas underlined the external resemblance of the new species to *Blanfordimys afghanus* (Thomas, 1912) and also its “normal” *Microtus* dentition and isolated geographic occurrence. Ellerman (1948), recognising three species of social voles, distinguished *M. irani* from *M. socialis* by its larger size and from *M. guentheri* by the greater bullae. Furthermore, in addition to the type locality, he also reported *M. irani* from Baghdad, Iraq. Ellerman & Morrison-Scott (1966) repeated Ellerman’s three species solution in their taxonomic compilation of Palaearctic mammals. Although this scheme has survived into modern times (e.g. Musser & Carleton 1993), it has not been adopted generally. Thus, Lay (1967) in his review of Iranian mammals and Harrison & Bates (1991) in a similar work on those of Arabia, lumped all social voles under the name *M. socialis*. In contrast, Corbet (1984), who distinguished only between *M. guentheri* and *M. socialis*, synonymised *M. irani* with the latter.

Kock et al. (1972) reported *M. irani* from several localities in eastern Turkey (Alişam, Norşun, Akçakale, Ceylânpınar, Tatvan), Syria (Tell Abiad) and Iran (Bijar in Kurdistan) - their determinations being supported by examination of the type specimen. Additional records of *M. irani* from Turkey, Syria, Israel and Iran were by Morlok (1978), Kock & Nader (1983), Nadachowski et al. (1990), and Çolak et al. (1997). In addition, Kock et al. (1972) and Kock & Nader (1983) provided drawings

of the skull and dentition, and Panteleyev et al. (1990) tentatively mapped the species' range.

Newly acquired evidence from Turkey and the Caucasus, supported by chromosomal data, suggests that the systematics of social voles are more complex than previously thought to be (Ahverdyan et al. 1991a, b, Çolak et al. 1997, Kefelioğlu & Kryštufek 1999). Recently, we collected social voles in eastern Anatolia, which cranially met the diagnostics provided by Kock et al. (1972) and Kock & Nader (1983) for *M. irani*, but possessed a *M. guentheri* karyotype (Kryštufek et al. in preparation). The redefinition of *M. irani* thus seems to be unavoidable in any attempt to resolve the taxonomy of the social voles of the Near East. This appears to be a difficult task, particularly as the karyotype of *M. irani* remains vague notably because of the absence of data from the type locality, but also as different authors have reported different chromosomal numbers for *M. irani*:  $2n = 62, 54, 60-64$ , and 46 (Zima & Král 1984, Çolak et al. 1997).

This paper thus aims to redescribe the type series of *Microtus irani*. Furthermore, we compare its morphological properties with the rich material of *M. cfr. irani* (in the sense of Kock et al. 1972). Finally, the definition of the species limits of *M. irani* also enabled us to elucidate the position of a population from central Anatolia that has the diploid number of  $2n = 60$ . We had previously described this population (Kefelioğlu & Kryštufek 1999), but hitherto hesitated to apply a specific name until the scope of *M. irani* had become better understood.

#### Material and Methods

We examined 4 specimens of *M. irani* (including the type) from the type series, 13 specimens of *M. anatolicus* sp. n. and rich comparative social vole material from Turkey, Lebanon, Syria, Israel, and Iran. Those specimens ( $n = 186$ ), which met the diagnosis for *M. irani* of Kock et al. (1972), are hereafter referred to as *M. cfr. irani*. Kryštufek & Kefelioğlu (submitted) demonstrated that *M. cfr. irani* is distinct from *M. socialis*. The specimens examined and the locations of collections are listed in the Appendix.

External measurements were recorded from specimen tags. Their abbreviations recorded in mm are: H&B – head and body length; TL – tail length; HF – hind foot length. Where total length was recorded, tail length was subtracted to obtain the head and body length. Fourteen linear measurements from each adult skull were taken with a dial calliper accurate to the nearest 0.05 mm. The abbreviations used are: CbL – condylobasal length of skull; RoL – rostrum length; NcL – neurocranium length; DiL – diastema length; MxT – maxillary tooth-row length; ZgB – zygomatic breadth; BcB1 – braincase breadth across bullae; BcB2 – braincase breadth across post-tympanic hook of the squamosal; IoC – interorbital constriction; BcH – braincase height incl. bullae; Bc – braincase height without bullae; RoH – height of rostrum at the anterior alveoli of the 1st upper molar; BuL – length of bullae; BuB – breadth of bullae.

The nomenclature of the enamel tooth pattern follows that of Van der Meulen (1973) and of the skull, Ognev (1963).

#### Results and Discussion

##### Redescription of *Microtus irani* Thomas, 1921

Thomas (in Cheesman 1921) examined 5 specimens, all from the type locality, however only 4 were available in the Natural History Museum (London) in October 1998. The type (20.5.20.9) was a skin and complete skull; of the three paratypes, one (20.5.20.8) was represented merely by a damaged skin, and the remainder (20.5.20.7 and – .10) were skins with broken skulls.

Type locality. – Thomas reported this as Bagh-i-Rezi, Shiraz, alt. 5,200', Fars Province, Iran.

External characteristics. – Thomas perceived the type series of *M. irani* to externally resemble *Blanfordimys afghanus*. The pelage is pale and sandy buff dorsally, whilst other social voles from Iran are generally darker. Also noticeable is the long tail, which appears relatively longer than in any other Iranian *M. cfr. irani* (Fig. 1).

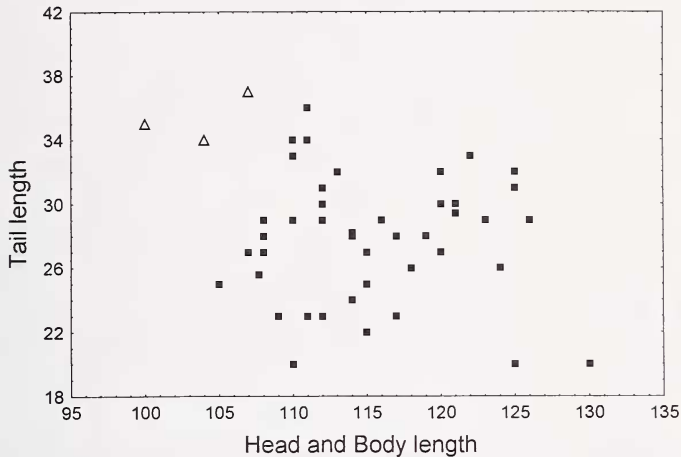


Fig. 1. Bivariate scatter plot of tail length against head and body length (in mm) for *Microtus irani* (triangles) and *M. cfr. irani* from Iran (squares).

Skull and dentition. – Although Thomas emphasised the large bullae of *M. irani*, this was not the case when the type was compared with *M. cfr. irani* from Iran. In fact, the bullae of two *M. irani* specimens are, in absolute numbers, of modest length (mean = 9.76 mm in *M. cfr. irani*; cf. Table 1) and slightly narrower than those seen in *M. cfr. irani*. This property became even more evident when the relative breadth of the bullae (expressed as a quotient with RoL as the denominator and multiplied by 100) was considered. Values of this ratio in two *M. irani* specimens are 36.7 and 38.7%, respectively, as opposed to the range of 39.5–47.5% in *M. cfr. irani*. The zygomatic arches are widely expanded forming 128.4% of the braincase breadth (BcB1) in the type of *M. irani* (the range in the Iranian *M. cfr. irani* was 106.4–123.1%). The incisive foramina are long in *M. irani* and reached posteriorly to the line connecting with the anterior margins of the alveoli of the first upper molars, whilst in *M. cfr. irani* the foramina are usually shorter (Fig. 2).

The alveolar process of the mandible is well pronounced and clearly visible in the caudal view, and part of the articular process distal to the alveolar process is short and heavy (Fig. 3). This, together with more projecting upper incisors than in *M. cfr. irani*, suggests the more fossorial habits of *M. irani*. The pronounced alveolar process is not size-related: in large *M. guentheri* from western Turkey and Europe it

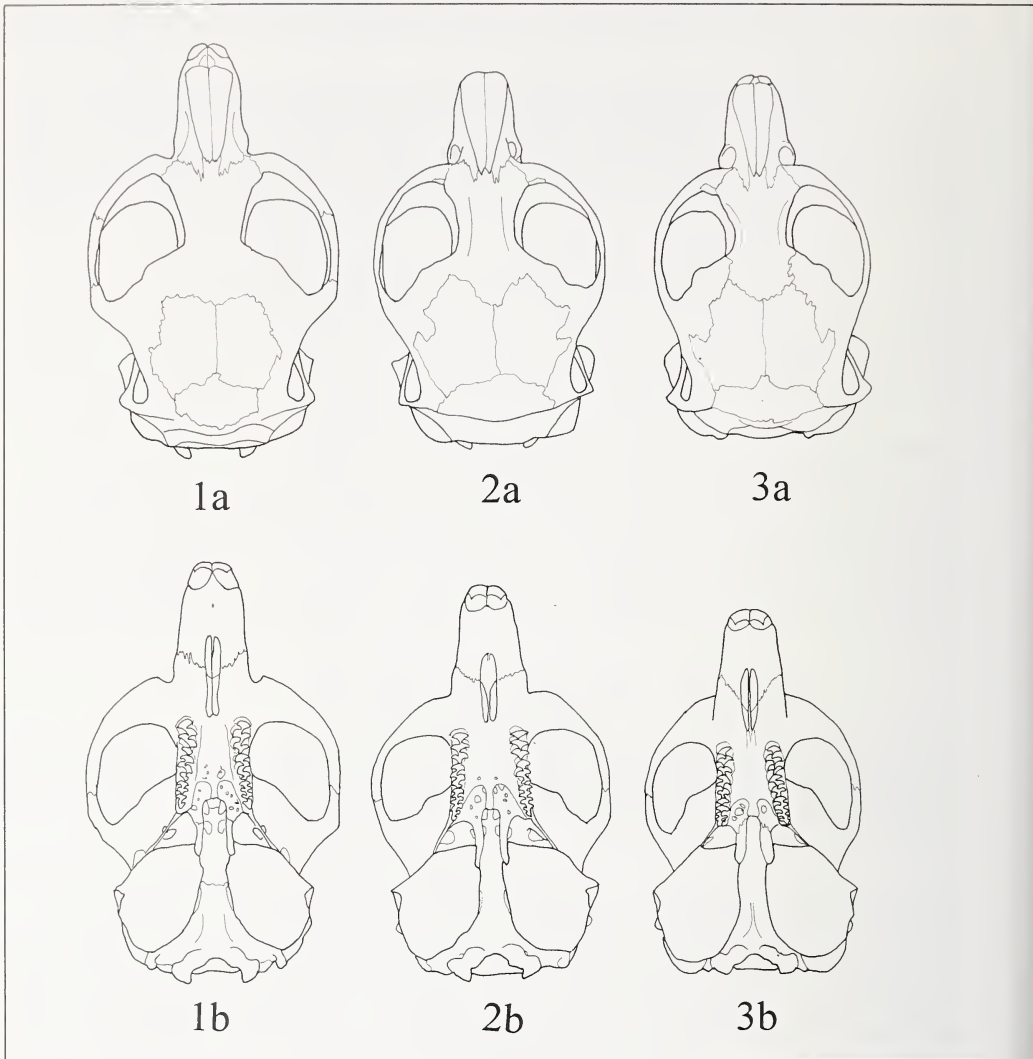
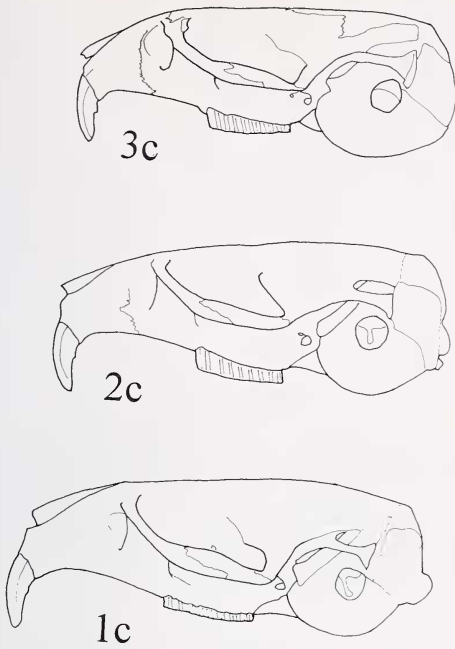


Fig. 2. Skulls of social voles in dorsal (a), ventral (b) and lateral view (c). 1 – *Microtus irani* (type specimen), 2 – *M. cf. irani* (USNM 369,635; 23 km north-north east Khaneh, west Azerbaijan, Iran); 3 – *M. anatolicus* sp. n. (type specimen).

is barely visible. The alveolar process is also very small in *Microtus philistinus* Thomas, 1917 and *Microtus mustersi* Hinton, 1926 – suggesting that neither are likely to be synonymous with *M. irani* (Musser & Carleton 1993). A strong alveolar process is, however, not an exclusive property of *M. irani*, but was also observed in *M. cf. irani* from Iran (Kangasar, Tehran) and from Turkey (SMF specimens from Muş and Alişam, both in the vicinity of Elazığ). Despite this, the alveolar process is



located more ventrally in *M. cfr. irani* with the distal-most portion of the articular process being longer and weaker (Fig. 3).

The first lower molar consists of five alternating triangles; triangles 6 and 7 are broadly confluent and connected to the anterior cap (Fig. 4). A similar pattern is also common among *M. cfr. irani*. The second upper molar has an additional postero-lingual loop in the type specimen, but its dentine field is connected with the field of the triangle anterior to it. The paratypes lack this loop which, however, was common among *M. cfr. irani* from Iran. In 7 geographic samples of *M. cfr. irani* the incidence of the accessory loop on the 2nd upper molar varied between 14.3% (Tehran) and 100% (western Azerbaijan) (median = 91.8%).

Table 1: Measurements in mm of *Microtus irani* types series and range for *Microtus cfr. irani* from Iran (n = 45 – 56). For abbreviations see text.

	<i>irani</i> Type	<i>irani</i> Paratype	<i>irani</i> Paratype	<i>irani</i> Paratype	<i>M. cfr. irani</i> min – max
H&B	107	104	100		105 – 130
TL	37	34	35	39	20 – 36
HF	19	19	18	19	16 – 22
CbL	30.1				27.1 – 30.6
RoL	17.7	16.8	16.6		15.6 – 17.9
NcL	16.3				14.7 – 16.9
DiL	9.0	8.1	8.7		7.7 – 9.1
MxT	7.0	6.5	6.2		6.2 – 7.6
ZgB	18.1		16.5		15.5 – 18.1
BcB1	14.4				13.6 – 15.7
BcB2	14.2				13.0 – 15.5
IoC	4.0	4.1	4.5		3.7 – 4.6
BcH	10.8				9.8 – 11.6
Bc	8.5				7.5 – 8.9
RoH	8.3	7.6	7.8		7.3 – 8.9
BuL	9.5	9.6			8.8 – 10.6
Bub	6.5	6.5			6.6 – 7.7

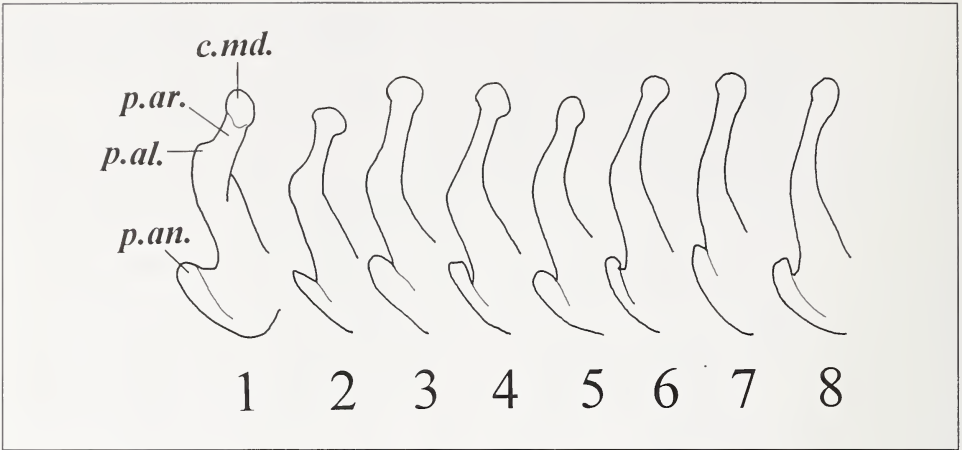


Fig. 3. Left mandibular ramus in caudal view. 1 – *M. irani* (type specimen); 2 – *M. cfr. irani* (SMF 53,706; Turkey, Muş); 3 – *M. cfr. irani* (SMF 47,576; Iran, Tehran, 18 km west of Karadj); 4 – *M. cfr. irani* (SMF 54,960; Israel, near Tel Aviv); 5 – *M. cfr. irani* (Lebanon, Mt. Sanine); 6 – *M. cfr. irani* (SMF 60,411; Syria, north of Lake Homs); 7 – *M. cfr. irani* (SMF 55,567; Israel, Ayanot); 8 – *M. anatolicus* sp. n. (type specimen). c.md. – mandibular head, p.ar. – articular process, p.al. – alveolar process, p.an. – angular process.

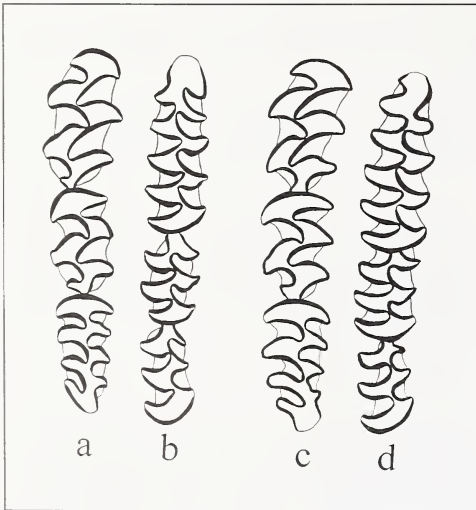


Fig. 4. Left upper (a, c) and right lower (b, d) molar tooth row in type specimens of *Microtus irani* (a, b) and *M. anatolicus* sp. n. (c, d).

Distribution. – Shiraz is located outside the known range of social voles – as already noticed by Thomas (in Cheesman 1921). Although our understanding of Iranian mammals has increased considerably since then (compare Lay 1967), a 500 km gap still separates Shiraz from the nearest known occurrence of *M. cfr. irani* at Aligüdarz, Lurestan (Fig. 5).

In conclusion, the type series of *M. irani* morphologically differs from that of *M. cfr. irani* voles living in Iran and Turkey. The characteristics considered are a longer tail, more expanded zygomatic arches, narrow bullae, and a strong alveolar process with

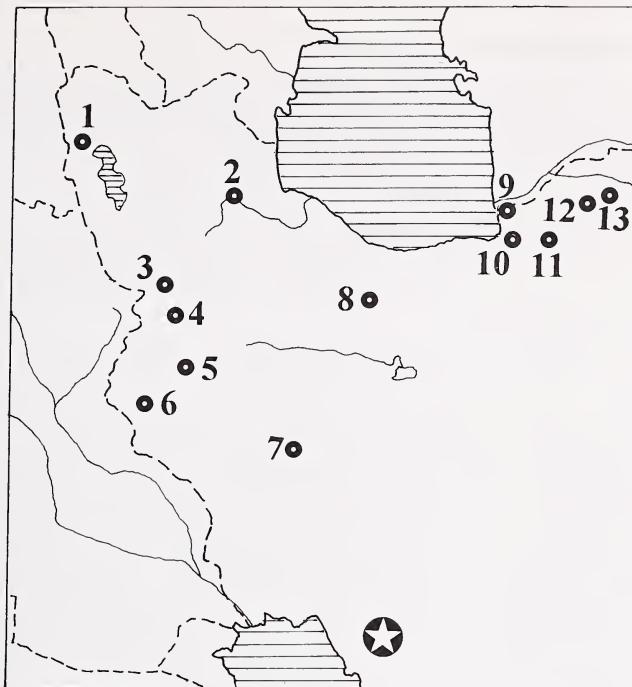


Fig. 5. Localities where *Microtus* cfr. *irani* was examined in Iran. Star denotes position of Shiraz, the type locality of *M. irani*. 1 – Western Azerbaijan, 23 km north-north-east Khaneh; 2 – Eastern Azerbaijan, 5 km south-east Mianeh; 3 – Kurdistan, 1.5 km south of Divandarreh; 4 – Kurdistan, vicinity of Sanadaj; 5 – Kangavar; 6 – Lurestan, 1.5 km north-west of Ilam; 7 – Lurestan, Aligudarz; 8 – Tehran, 18 km west of Karadj; Qazvin, 15 km south of Karadj; 9 – Gorgan, Pahlavi Dezh; 10 – Khorassan, 25 km east of Gorgan; 11 – Khorassan, Dergematie; 12 – Khorassan, vicinity of Dasht; Gowadoh. 13 – Khorassan, 3 km south of Kaur.

a short and heavy distal portion on the articular process in *M. irani*. Lacking karyological data from Iran, it is best to consider *M. irani* as an independent species, known solely from its type locality.

The identity of *Microtus* “*socialis*”  $2n = 60$

*Microtus* “*socialis*”  $2n = 60$  was described by Kefelioğlu & Kryštufek (1999). Their description was based on 13 specimens, all collected from a single locality in the vicinity of Konya, Turkey. Because the diploid number of  $2n = 60$  had already been reported for *M. irani* (Zima & Král 1984), we hesitated to apply a specific name until the scope of *M. irani* had become better understood. It is now evident that the Konya voles are morphologically very different from true *M. irani*. Furthermore, they also differ, both karyologically and morphologically, from other Turkish social voles, and thus deserve to be recognised as a new species.

*Microtus anatolicus* sp. n.

Holotype. – An adult male, held in the Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn. ZFMK 99.926 (OMUS 721), skin (with no tail) and skull, obtained 20 July 1993 by H. Kefelioğlu.

Type locality. – Turkey, Konya, Cihanbeyli, Yapalı köyü.

Diagnosis. – Bullae very large (BuL > 35% of CbL; in other social voles from Anatolia BuL < 35% of CbL). Mastoid portion of bullae protrudes caudally (Fig. 2). Diploid number of chromosomes  $2n = 60$ , NFa = 60; for details on chromosomes see Kefelioğlu & Kryštufek (1999).

Etymology. – Anatolia (Anadolu) is the name for Asiatic Turkey.

Description. – A medium-sized and short-tailed social vole. Pelage soft, back pale yellowish brown to greyish brown, belly whitish with greyish or yellowish shades; no demarcation line on flanks. Tail uniformly greyish brown, paws whitish. Skull robust and deep; supraorbital ridges present but separated and not forming a sagittal crest. Median carina usually low and broad, never high and sharp. Alveolar process of the mandible weak, not pronounced (Fig. 3). First lower molar with five closed alternating triangles; triangles 6 and 7 broadly confluent with dental fields integrated into the anterior cup. An additional postero-lingual triangle as seen in the type specimen of *M. anatolicus* sp. n. (Fig. 4) is exceptional in this species; but the dental field was not closed in any specimen. Third upper molar with three ( $n = 7$ ) or four re-entrant angles ( $n = 6$ ) on its lingual side. For measurements see Table 2. A photograph of a skin and skull of the new species was published by Kefelioğlu & Kryštufek (1999) who compared it with the remaining Turkish social voles by Discriminant Function Analysis.

Table 2: Measurements of *Microtus anatolicus* sp. n. type series. For abbreviations see text.

	Type ZFMK 99.926	OMUS 713	OMUS 716	OMUS 717	OMUS 719	OMUS 720	OMUS 722
H&B	119	117	113	115	109	117	125
TL	25	25	34	28	25	33	34
HF	21	20	22	23	19	22	22
CbL	28.1	27.3	28.7	27.2	27.55	27.3	29.2
RoL	16.7	15.1	16.6	15.7	16.0	15.6	16.85
NcL	16.3	16.15	16.8	15.8	15.7	15.4	16.1
DiL	8.25	7.8	8.5	8.0	8.25	8.3	8.8
MxT	6.65	6.35	6.6	6.1	6.4	6.0	6.95
ZgB	16.3	15.6	16.7	15.5	16.0	15.8	17.7
BcB1	15.7	15.0	15.1	13.9	14.9	13.9	15.4
BcB2	15.25	14.4	14.6	13.6	14.55	14.0	14.85
IoC	3.75	4.0	4.0	3.8	4.15	3.7	3.8
BcH	11.3	11.45	11.2	10.5	11.55	10.8	11.0
Bc	8.65	8.8	8.2	8.0	8.4	8.1	8.5
RoH	8.2	7.8	8.1	7.7	7.85	7.8	8.2
BuL	10.5	9.8	10.5	9.7	9.6	9.8	10.2
BuB	7.85	7.5	7.6	7.1	7.5	7.4	7.75



Comparisons. – For details on chromosomal differences between the new species and the three other social voles from Turkey (*M. guentheri*, *M. socialis*, *M. dogramaci*) see Kefelioğlu & Kryštufek (1999). The new species closely resembles *M. socialis* karyologically. The two share the same fundamental number of autosomes, but differ in diploid number:  $2n = 62$  in *M. socialis* and 60 in *M. anatolicus* sp. n.. The single small metacentric in *M. anatolicus* sp. n. possibly resulted from a fusion of two small acrocentrics (Matthey 1973). However, categorical cranial differences provide strong evidence against restricting the new species to a merely Robertsonian population of *M. socialis*.

*Microtus guentheri* (Danford & Alston, 1880) of western Anatolia is larger with a more robust skull but with shorter bullae and a narrower braincase (Fig. 6). Moreover, all *M. guentheri* we have examined so far were brown, whilst the new species is greyish. The exact scope of *M. guentheri* in eastern Anatolia and possibly in adjacent parts of Iran is far from clear. The topotypes of *M. guentheri shevketi* Neuhäuser, 1936 have a *guentheri* karyotype (Kefelioğlu & Kryštufek 1999) and *Microtus philistinus* morphologically fits *M. guentheri* of western Anatolia (Fig. 6). The few specimens in our possession from eastern Anatolia with *M. guentheri* karyotype are smaller and with longer bullae compared to *M. guentheri* from western Anatolia, but not differing cranially from *M. cfr. irani*. The latter differed from the new species by relatively smaller bullae, a narrower braincase (Fig. 7) and, judging from the Anatolian samples, also by karyotype.

*Microtus irani* is characterised by a longer tail, more projecting upper incisors, relatively shorter bullae and a narrower braincase. Bullae breadth (BuB) attained 36.7% of rostrum length (RoL) in *M. irani*, but > 45% in *M. anatolicus* sp. n. Similarly, the braincase breadth (BcB2) was 80.2% of rostrum length in *M. irani*, but > 86% in the new species.

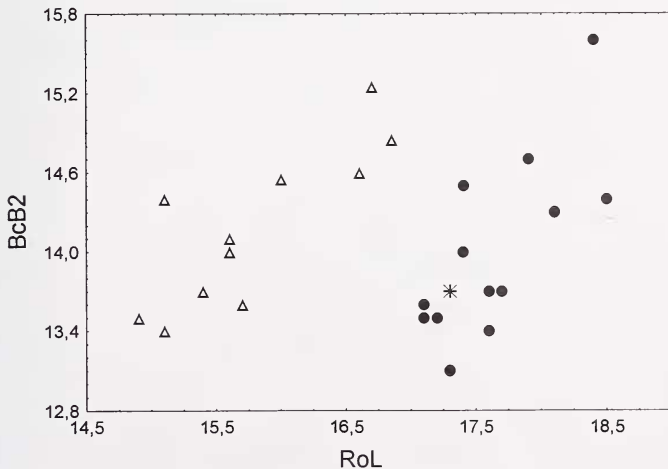


Fig. 6. Bivariate scatter plot of braincase breadth across bullae (BcB2) against length of rostrum (RoL) (in mm) for *Microtus anatolicus* sp. n. (triangles), *M. guentheri* from west Anatolia (dots) and the type of *Microtus philistinus* (star).

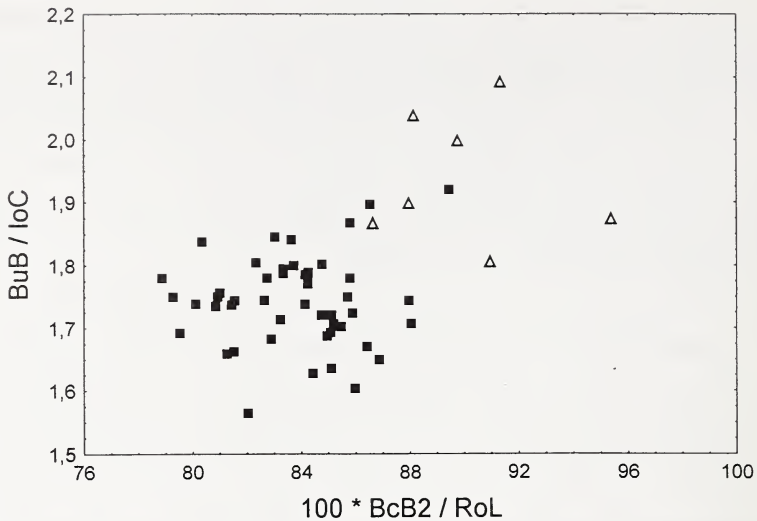


Fig. 7. Bivariate scatter plot of two ratios for *Microtus anatolicus* sp. n. (triangles) and *Microtus cfr. irani* (squares). See text for explanation of variable identities.

*Microtus dogramaci* Kefelioğlu & Kryštufek, 1999 closely resembles the new species but is smaller, with shorter bullae and a shallower skull, particularly across the rostrum (Fig. 8). The overlap seen in Fig. 8 was due to subadults of the new species, while fully adult specimens clearly differ from adult *M. dogramaci*.

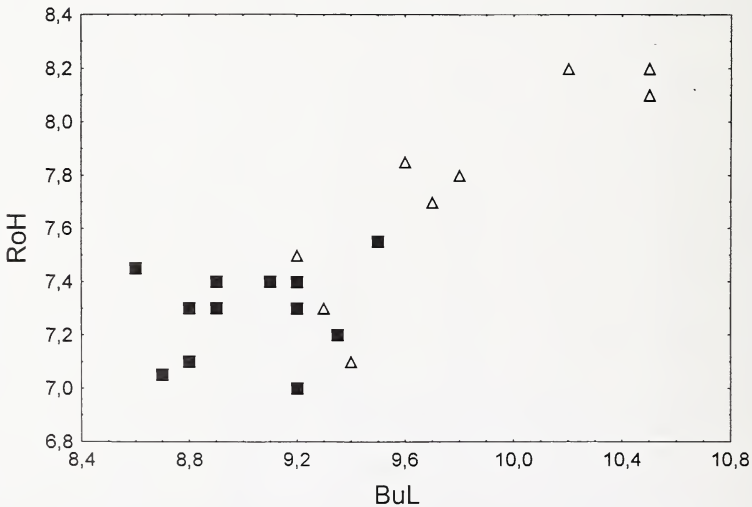


Fig. 8. Bivariate scatter plot of height of rostrum (RoH) against length of bullae (BuL) (in mm) for *Microtus anatolicus* sp. n. (triangles) and *M. dogramaci* (squares).

*Microtus socialis* (Pallas, 1773) is the smallest vole in the Near East, and also has the shallowest skull (Figs. 9, 10). Adults of the two species clearly differ, but subadults of *M. anatolicus* sp. n. overlap marginally with the largest specimens of *M. socialis*.

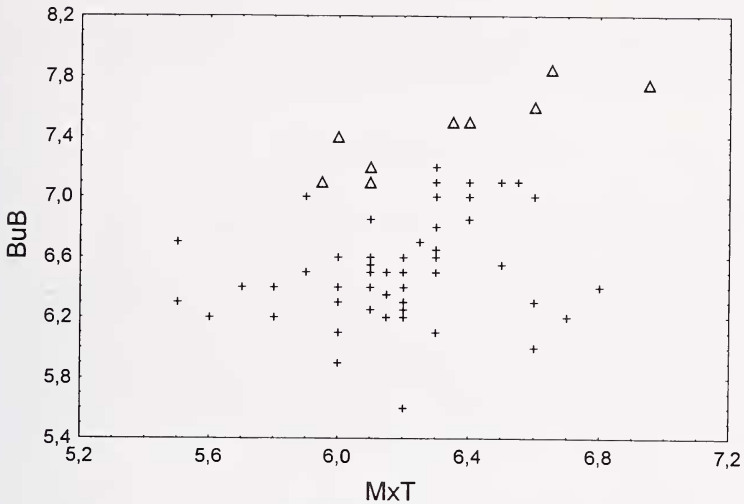


Fig. 9. Bivariate scatter plot of bullae breadth (BuB) against maxillary tooth-row length (MxT) (in mm) for *Microtus anatolicus* sp. n. (triangles) and *M. socialis* (crosses).

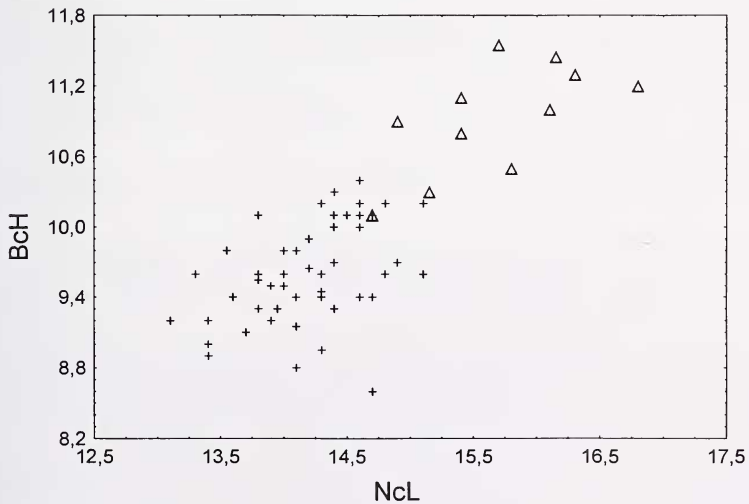


Fig. 10. Bivariate scatter plot of braincase height (BcH) against length of neurocranium (NcL) (in mm) for *Microtus anatolicus* sp. n. (triangles) and *M. socialis* from the Near East (crosses).

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### Zusammenfassung

Die Typenserie von *Microtus irani* unterscheidet sich morphologisch von den soziallebenden Wühlmäusen aus dem Iran und der Türkei, die aber bisher dieser Art zugerechnet wurden. Unterscheidungsmerkmale sind ein längerer Schwanz, ausladendere Jochbögen, schmalere Bullae und ein ausgeprägter Alveolar-Fortsatz mit einem kurzen und massiven distalen Teil des Gelenkfortsatzes (processus articularis) in echten *Microtus irani*. Solange keine karyologischen Werte aus dem Iran vorliegen, sollte *M. irani* als eigenständige Art betrachtet werden, die nur aus der Typuslokalität bekannt ist. Allerdings unterscheiden sich die sozialen Wühlmäuse aus Zentral-Anatolien mit dem diploiden Chromosomensatz  $2n = 60$ , wie sie von Kefeliöglu & Kryštufek (1999) beschrieben werden, morphologisch stark von *M. irani*. Diese Wühlmäuse stellen eine neue Art dar, *Microtus anatolicus* sp. n., die sich von sozialen Wühlmäusen der Türkei durch deutlich vergrößerte Bullae abhebt.

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#### Appendix: List of specimens examined

Information concerning *Microtus socialis* is summarised by Kryštufek & Kefelioğlu (submitted); a list of *M. guentheri* will be provided elsewhere (Kryštufek et al. in preparation). The collection's acronyms follow Genoways & Schlitter (1981) and Hafner et al. (1997). AMNH – American Museum of Natural History, New York, USA; BMNH – Natural History Museum London, UK; FMNH – The Field Museum, Chicago, USA; OMUS – Ondokuz Mayıs University, Samsun, Turkey; SMF – Forschungsinstitut und Natur-Museum Senckenberg, Frankfurt, Germany; USNM – United States National Museum of Natural History, Washington D.C., USA; ZFMK – Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany.

*Microtus irani* (type series). – Iran, Shiraz (BMNH n = 4). – *Microtus anatolicus* sp. n. (type series). – Turkey, Konya, Cihanbeyli, Yapalı köyü (OMUS n = 12, ZFMK n = 1). – *Microtus* cf. *irani*. – Turkey: 50 km west Muş (SMF n = 2); Elazığ, Alişam (SMF = 1). Lebanon: south

slope of Mt. Sanine, 2000 m (SMF n = 2). Syria: north of dam on Lake Homs, Orontes (SMF n = 1). Israel: Tel Aviv, Givat Brenner (SMF n = 3); Ayanot, Ramla (SMF n = 4). Iran: Western Azerbaijan, 23 km north-north-east Khaneh (USNM n = 25); Eastern Azerbaijan, 5 km south-east Mianeh (USNM n = 6); Kurdistan, 1.5 km south of Divandarreh (FMNH n = 3); Kurdistan, vicinity of Sanadaj (USNM n = 39); Kangavar (BMNH n = 1); Lurestan, 1.5 km north-west of Ilam (FMNH n = 12); Lurestan, Aliğudarz (FMNH n = 3); Tehran, 18 km west of Karadj (SMF n = 4); Qazvin, 15 km south of Karadj (FMNH n = 3); Gorgan, Pahlavi Dezh (SMF n = 4); Khorassan, 25 km east Gorgan (USNM n = 2); Khorassan, Dergematie (AMNH n = 6); Khorassan, vicinity of Dasht (USNM n = 54, FMNH n = 5, AMNH n = 2); Khorassan, Gowadoh (AMNH n = 1); Khorassan, 3 km south of Kaur (FMNH n = 3). – *Microtus dogramaci* (type series). – Turkey: Konya, Cihanbeyli (OMUS n = 12); Amasya, Sulova, Boyali köyü (OMUS n = 14). – *Microtus philistinus* (the type). – Israel, Jaffa, Ekron (BMNH n = 1). – *Microtus mustersi* (the type). – Libya, Cyrenaica, Merg (BMNH n = 1).